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GROUP ART UNIT 2877

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
RICHARD J. MARKLE
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J. BROCK STIRTON
MARILYN I. WRIGHT

Serial No.: 09/897,576

Filed: July 2, 2001

For: METHOD AND APPARATUS FOR DETERMINING CONTACT OPENING DIMENSIONS USING SCATTEROMETRY

Examiner: SANG H. NGUYEN

Group Art Unit: 2877

Att'y Docket: 2000.071100/SFD

Client Ref.: TT4355

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APPEAL BRIEF

Mail Stop Appeal Brief – Patents
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Sir:

Applicants hereby submit this Appeal Brief to the Board of Patent Appeals and Interferences in response to the final Office Action dated January 16, 2004.. The fee for filing this Appeal Brief is $330.

The Director is authorized to deduct the fee ($330) for filing this Appeal Brief and any other fees required under 37 C.F.R. §§ 1.16 to 1.21 from Advanced Micro Devices, Inc. Deposit Account No. 01-0365/TT4355. In the event the monies in that account are insufficient, the Director is authorized to withdraw funds from Williams, Morgan & Amerson, P.C. Deposit Account No. 50-0786/2000.071100.

I. REAL PARTY IN INTEREST

The assignee of this application is Advanced Micro Devices, Inc.

II. RELATED APPEALS AND INTERFERENCES

No other appeals or interference known to appellant will directly affect, be directly affected by, or have a bearing on the Board's decision in this appeal.

III. STATUS OF THE CLAIMS

Claims 1-72 have been rejected. Claims 73 and 74 are not mentioned in the final Office Action. For purposes of this appeal Applicants assume claims 73 and 74 were intended to be rejected, but inadvertently omitted. Claims 1-74 are the subject of this appeal.

IV. STATUS OF AMENDMENTS

All amendments have been entered.

V. SUMMARY OF THE INVENTION

Independent claims 1, 13, 23, 33, 40, 50, 51, and 63 include the general feature of illuminating a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines. Light reflected from the contact openings is measured to determine a dimension of the contact openings based on the measured reflection profile.

Independent claim 52 is directed to the test structure including a plurality of lines and a plurality of contact openings defined in the lines.

VI. ISSUES ON APPEAL

A. Whether claims 52-53 and 57-62 are anticipated under 35 U.S.C. § 102(b) by United States Patent No. 5,686,747 (Jost).

B. Whether claims 1-72 are anticipated under 35 U.S.C. § 102(a) by United States Patent No. 6,366,688 (Jun).

C. Whether claims 54-56 are obvious under 35 U.S.C. § 103(a) over Jun.

VII. GROUPING OF THE CLAIMS

Claims 52-62 and 73 may be considered as a first group that stands or falls together.

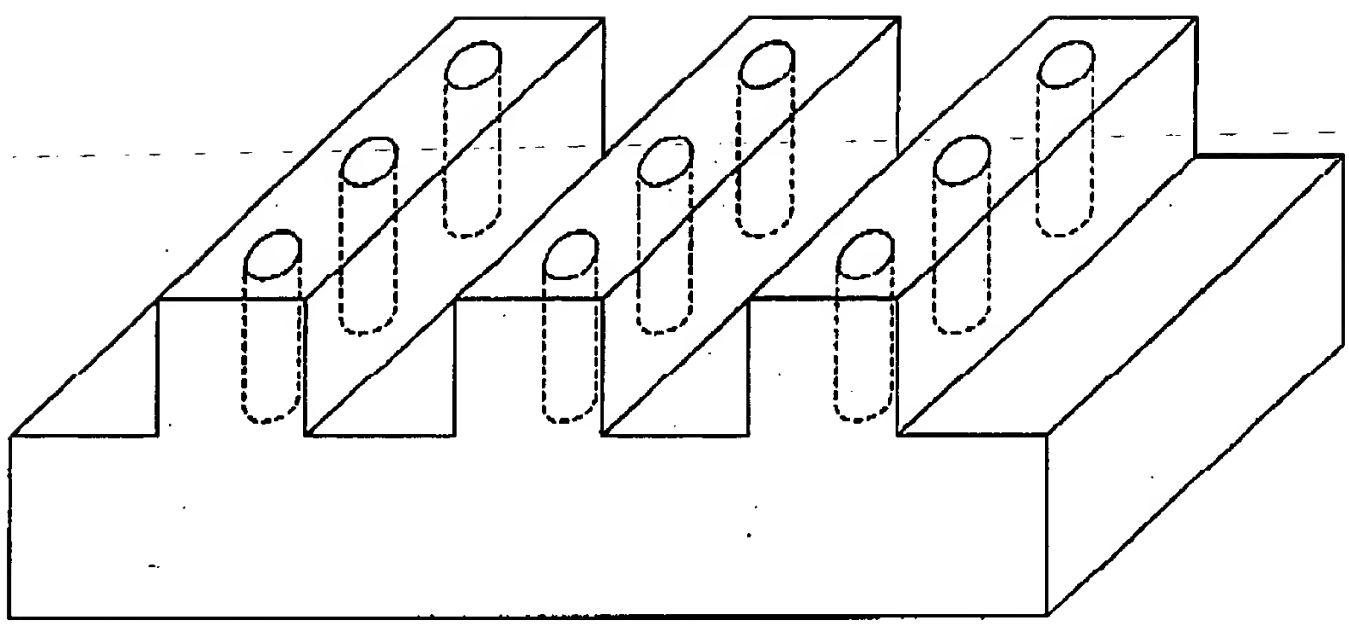
Claims 1-51, 63-72, and 74 may be considered as a second group that stands or falls together.

VIII. ARGUMENT

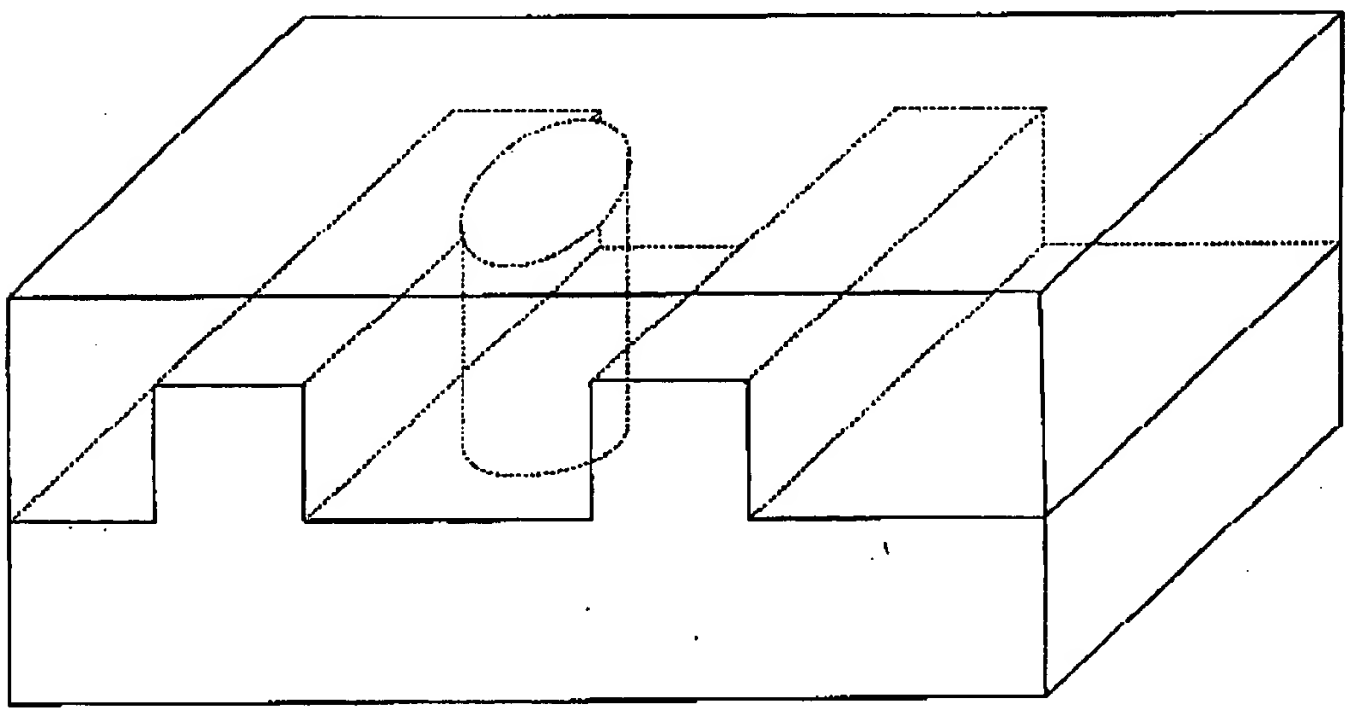
A. Claims 52-53 and 57-62 are not anticipated under 35 U.S.C. § 102(b) by United States Patent No. 5,686,747 (Jost).

Claims 52, 53 and 57-62 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,686,747 (Jost). For purposes of this appeal, claim 73 that was not specifically addressed by the Office Action is assumed to be included in this group.

The test structure set forth in claim 52 includes a plurality of lines with a plurality of contact openings defined in the lines. Figure 1 below illustrates this arrangement.



The Office Action asserts that Jost teaches these features. To the contrary, Jost teaches a plurality of lines, with contact openings defined between the lines, not in the lines. Figure 2 below illustrates the cross section view of Figure 2 of Jost in a simplified isometric view.



Referring to Figure 2 of Jost, the lines 12, 14, 16 extend into the page, the contact openings 32, 34 are formed in the insulative material between the lines to contact the underlying source/drain regions. During the formation of the contact openings 32, 34 a small portion of the insulating material is removed on the periphery of the contact opening, but the line is unaffected. However, this portion is minimal as compared to the cross section of the contact opening. The purpose of the contact opening is to contact the source/drain regions between the lines, and the portion that impinges on the line structures is incidental. Moreover, forming the contact openings in the lines would defeat the purpose of Jost, which is to contact the source/drain regions. If Jost were to form the contact openings in the lines, the source/drain regions would not be contacted and the devices would be rendered inoperable as the gate electrodes would be destroyed. Accordingly, Jost does not teach or suggest a structure with a plurality of lines and contact openings defined in the lines. Accordingly, claim 52, and all claims depending therefrom, are allowable over Jost. Applicants respectfully request the rejection of claims 52, 53, and 57-62 be reversed.

Moreover, claims 59-62 depend from claim 54, which was not rejected under 35 U.S.C. § 102(b). Inherently, claims 59-62 are narrower than claim 54, and accordingly cannot be anticipated if the broader parent claim is not anticipated. Accordingly, Applicants requests the rejection of claims 59-62 be reversed for these additional reasons.

B. Claims 1-72 are not anticipated under 35 U.S.C. § 102(a) by United States Patent No. 6,366,688 (Jun).

Claims 1-72 stand rejected under 35 U.S.C. § 102(a) as being anticipated by U.S. Patent No. 6,366,688 (Jun). For purposes of this appeal, claims 73 and 74 that were not specifically addressed by the Office Action is assumed to be included in this group.

Independent claims 1, 13, 23, 33, 40, 50, 51, and 63 include the general feature of illuminating a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines. Light reflected from the contact openings is measured to determine a dimension of the contact openings based on the measured reflection profile. Claim 52 is directed to the test structure.

The Office Action asserts that Jun teaches these features. To the contrary, Jun fails to teach or suggest a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines. The office action cites Figures 19 and 20 as showing such a structure. However, Figures 19 and 20 do not illustrated lines, but rather, an artificial mesh structure. "The grid or mesh structure typically includes a pair of mutually orthogonal axes **superimposed over the image** of the portion of the wafer being analyzed." (emphasis added, see col. 3, lines 13-15) Hence, the grid structure shown in Figures 19 and 20 is simply an artificial grid formed on the image generated by the scanning electron microscope image of the wafer. Jun shows only a planar surface with a plurality of contact openings, not a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines. Moreover, Jun employs a scanning electron microscope, not a light source, and does not generate a reflection profile, but rather, an optical image of the wafer. Accordingly, claims 1, 13, 23, 33, 40, 50, 51, 63, and all claims

depending therefrom, are allowable. Applicants respectfully request the rejection of claims 1-74 be reversed.

C. Claims 54-56 are not obvious under 35 U.S.C. § 103(a) over Jun.

Claims 54-56 stand rejected as being obvious under 35 U.S.C. § 103(a) over Jun. Claims 54-56 are allowable for at least the reasons provided above regarding their parent claim 52. Applicants respectfully request the rejection of claims 54-56 be reversed.

D. Conclusion

Applicants contend that the prior art does not anticipate or obviate any of the pending claims. Applicants respectfully requests that the rejections of all of the claims be reversed.

Respectfully submitted,

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APPENDIX

Claims involved in this appeal:

1. (Original) A method for determining contact opening dimensions, comprising:

providing a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines;

illuminating at least a portion of the contact openings with a light source;

measuring light reflected from the illuminated portion of the contact openings to generate a reflection profile; and

determining a dimension of the contact openings based on the reflection profile.

2. (Original) The method of claim 1, wherein determining the dimension of the contact openings further comprises:

comparing the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated contact opening dimension metric;

selecting a reference reflection profile closest to the generated reflection profile; and

determining the dimension of the contact openings based on the contact opening dimension metric associated with the selected reference reflection profile.

3. (Original) The method of claim 1, further comprising determining at least one parameter of an operating recipe of a etch tool adapted to etch a subsequent wafer based on the determined contact opening dimension.

4. (Original) The method of claim 3, wherein determining at least one parameter of the operating recipe of the etch tool comprises determining at least one of an etch time parameter, a plasma chemical composition parameter, an RF power parameter, a gas flow parameter, a chamber temperature parameter, a chamber pressure parameter, and an end-point signal parameter.

5. (Original) The method of claim 1, further comprising determining at least one parameter of an operating recipe of a photolithography tool adapted to process a subsequent wafer based on the determined contact opening dimension.

6. (Original) The method of claim 5, wherein determining at least one parameter of the operating recipe of the photolithography tool comprises determining at least one of an exposure time parameter, an exposure dose parameter, a depth of focus parameter, a resist spin speed parameter, a soft bake temperature parameter, a post exposure bake temperature parameter, a cool plate temperature parameter, a developer temperature parameter, and a focus tilt parameter.

7. (Original) The method of claim 1, wherein generating the reflection profile comprises generating the reflection profile based on at least one of intensity and phase of the reflected light.

8. (Original) The method of claim 1, wherein determining the dimension of the contact openings further comprises:

comparing the generated reflection profile to a target reflection profile; and

determining the dimension of the contact openings based on the comparison of the generated reflection profile and the target reflection profile.

9. (Original) The method of claim 1, further comprising identifying a fault condition associated with the contact openings based on the determined contact opening dimension.

10. (Original) The method of claim 1, wherein determining the dimension of the contact openings further comprises determining at least one of a diameter dimension, a depth dimension, and a sidewall angle dimension.

11. (Original) The method of claim 1, wherein providing the wafer further comprises providing the wafer having the test structure comprising the plurality of lines and the plurality of contact openings defined in the lines, the contact openings in one line being aligned with the contact openings in an adjacent line.

12. (Original) The method of claim 1, wherein providing the wafer further comprises providing the wafer having the test structure comprising the plurality of lines and the plurality of contact openings defined in the lines, the contact openings in one line being offset with respect to the contact openings in an adjacent line.

13. (Original) A method for determining contact opening dimensions, comprising:

providing a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines;

illuminating at least a portion of the contact openings with a light source;

measuring light reflected from the illuminated portion of the contact openings to generate a reflection profile;

comparing the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated contact opening dimension metric;

selecting a reference reflection profile closest to the generated reflection profile; and

determining a dimension of the contact openings based on the contact opening dimension metric associated with the selected reference reflection profile.

14. (Original) The method of claim 13, further comprising determining at least one parameter of an operating recipe of a etch tool adapted to etch a subsequent wafer based on the determined contact opening dimension.

15. (Original) The method of claim 14, wherein determining at least one parameter of the operating recipe of the etch tool comprises determining at least one of an etch time parameter, a plasma chemical composition parameter, an RF power parameter, a gas flow parameter, a chamber temperature parameter, a chamber pressure parameter, and an end-point signal parameter.

16. (Original) The method of claim 13, further comprising determining at least one parameter of an operating recipe of a photolithography tool adapted to process a subsequent wafer based on the determined contact opening dimension.

17. (Original) The method of claim 16, wherein determining at least one parameter of the operating recipe of the photolithography tool comprises determining at least one of an exposure time parameter, an exposure dose parameter, a depth of focus parameter, a resist spin speed parameter, a soft bake temperature parameter, a post exposure bake temperature parameter, a cool plate temperature parameter, a developer temperature parameter, and a focus tilt parameter.

18. (Original) The method of claim 13, wherein generating the reflection profile comprises generating the reflection profile based on at least one of intensity and phase of the reflected light.

19. (Original) The method of claim 13, further comprising identifying a fault condition associated with the contact openings based on the determined contact opening dimension.

20. (Original) The method of claim 13, wherein determining the dimension of the contact openings further comprises determining at least one of a diameter dimension, a depth dimension, and a sidewall angle dimension.

21. (Original) The method of claim 13, wherein providing the wafer further comprises providing the wafer having the test structure comprising the plurality of lines and the plurality of contact openings defined in the lines, the contact openings in one line being aligned with the contact openings in an adjacent line.

22. (Original) The method of claim 13, wherein providing the wafer further comprises providing the wafer having the test structure comprising the plurality of lines and the plurality of contact openings defined in the lines, the contact openings in one line being offset with respect to the contact openings in an adjacent line.

23. (Original) A method for determining contact opening dimensions, comprising:

providing a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines;

illuminating at least a portion of the contact openings with a light source;

measuring light reflected from the illuminated portion of the contact openings to generate a reflection profile; and

comparing the generated reflection profile to a target reflection profile; and

determining a dimension of the contact openings based on the comparison of the generated reflection profile and the target reflection profile.

24. (Original) The method of claim 23, further comprising determining at least one parameter of an operating recipe of a etch tool adapted to etch a subsequent wafer based on the determined contact opening dimension.

25. (Original) The method of claim 24, wherein determining at least one parameter of the operating recipe of the etch tool comprises determining at least one of an etch time parameter, a plasma chemical composition parameter, an RF power parameter, a gas flow parameter, a chamber temperature parameter, a chamber pressure parameter, and an end-point signal parameter.

26. (Original) The method of claim 23, further comprising determining at least one parameter of an operating recipe of a photolithography tool adapted to process a subsequent wafer based on the determined contact opening dimension.

27. (Original) The method of claim 26, wherein determining at least one parameter of the operating recipe of the photolithography tool comprises determining at least one of an exposure time parameter, an exposure dose parameter, a depth of focus parameter, a resist spin speed parameter, a soft bake temperature parameter, a post exposure bake temperature parameter, a cool plate temperature parameter, a developer temperature parameter, and a focus tilt parameter.

28. (Original) The method of claim 23, wherein generating the reflection profile comprises generating the reflection profile based on at least one of intensity and phase of the reflected light.

29. (Original) The method of claim 23, further comprising identifying a fault condition associated with the contact openings based on the determined contact opening dimension.

30. (Original) The method of claim 23, wherein determining the dimension of the contact openings further comprises determining at least one of a diameter dimension, a depth dimension, and a sidewall angle dimension.

31. (Original) The method of claim 23, wherein providing the wafer further comprises providing the wafer having the test structure comprising the plurality of lines and the plurality of contact openings defined in the lines, the contact openings in one line being aligned with the contact openings in an adjacent line.

32. (Original) The method of claim 23, wherein providing the wafer further comprises providing the wafer having the test structure comprising the plurality of lines and the plurality of contact openings defined in the lines, the contact openings in one line being offset with respect to the contact openings in an adjacent line.

33. (Original) A metrology tool adapted to receive a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines, comprising:

a light source adapted to illuminate at least a portion of the contact openings;

a detector adapted to measure light reflected from the illuminated portion of the contact openings to generate a reflection profile; and

a data processing unit adapted to determine a dimension of the contact openings based on the reflection profile.

34. (Original) The metrology tool of claim 33, wherein the data processing unit is further adapted to compare the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated contact opening dimension metric, select a reference reflection profile closest to the generated reflection profile, and determine the dimension of the contact openings based on the contact opening dimension metric associated with the selected reference reflection profile.

35. (Original) The metrology tool of claim 33, wherein the detector is further adapted to generate the reflection profile based on at least one of intensity and phase of the reflected light.

36. (Original) The metrology tool of claim 33, wherein the metrology tool comprises at least one of a scatterometer, an ellipsometer, and a reflectometer.

37. (Original) The metrology tool of claim 33, wherein the data processing unit is further adapted to compare the generated reflection profile to a target reflection profile and determine the dimension of the contact openings based on the comparison of the generated reflection profile and the target reflection profile.

38. (Original) The metrology tool of claim 33, wherein the contact openings in one line are aligned with the contact openings in an adjacent line.

39. (Original) The metrology tool of claim 33, wherein the contact openings in one line are offset with respect to the contact openings in an adjacent line.

40. (Original) A processing line, comprising:

a processing tool adapted to process wafers in accordance with an operating recipe;

a metrology tool adapted to receive a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines, the metrology tool comprising:

a light source adapted to illuminate at least a portion of the contact openings;

a detector adapted to measure light reflected from the illuminated portion of the contact openings to generate a reflection profile; and

a data processing unit adapted to determine a dimension of the contact openings based on the reflection profile; and

a controller adapted to determine at least one parameter of the operating recipe of the processing tool based on the determined contact opening dimension.

41. (Original) The processing line of claim 40, wherein the data processing unit is further adapted to compare the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated contact opening dimension metric, select a reference reflection profile closest to the generated reflection profile, and determine the dimension of the contact openings based on the contact opening dimension metric associated with the selected reference reflection profile.

42. (Original) The processing line of claim 40, wherein the detector is further adapted to generate the reflection profile based on at least one of intensity and phase of the reflected light.

43. (Original) The processing line of claim 40, wherein the metrology tool comprises at least one of a scatterometer, an ellipsometer, and a reflectometer.

44. (Original) The processing line of claim 40, wherein the data processing unit is further adapted to compare the generated reflection profile to a target reflection profile and determine the dimension of the contact openings based on the comparison of the generated reflection profile and the target reflection profile.

45. (Original) The processing line of claim 40, wherein the processing tool further comprises an etch tool, and the controller is further adapted to determine at least one of an etch time parameter, a plasma chemical composition parameter, an RF power parameter, a gas flow parameter, a chamber temperature parameter, a chamber pressure parameter, and an end-point signal parameter.

46. (Original) The processing line of claim 40, wherein the processing tool further comprises a photolithography tool, and the controller is further adapted to determine at least one of an exposure time parameter, an exposure dose parameter, a depth of focus parameter, a resist spin speed parameter, a soft bake temperature parameter, a post exposure bake temperature

parameter, a cool plate temperature parameter, a developer temperature parameter, and a focus tilt parameter.

47. (Original) The processing line of claim 40, wherein the contact openings in one line are aligned with the contact openings in an adjacent line.

48. (Original) The processing line of claim 40, wherein the contact openings in one line are offset with respect to the contact openings in an adjacent line.

49. (Original) The processing line of claim 40, wherein the controller is further adapted to identify a fault condition associated with the contact openings based on the determined contact opening dimension.

50. (Original) A metrology tool adapted to receive a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines, comprising:

a light source adapted to illuminate at least a portion of the contact openings;

a detector adapted to measure light reflected from the illuminated portion of the contact openings to generate a reflection profile; and

a data processing unit adapted to compare the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated contact opening dimension metric, select a reference reflection profile closest to the generated reflection profile, and determine a dimension of the contact

openings based on the contact opening dimension metric associated with the selected reference reflection profile.

51. (Original) A metrology tool adapted to receive a wafer having a grating structure comprising a plurality of lines, comprising:

a light source adapted to illuminate at least a portion of the contact openings;

a detector adapted to measure light reflected from the illuminated portion of the contact openings to generate a reflection profile; and

a data processing unit adapted to compare the generated reflection profile to a target reflection profile and determine a dimension of the contact openings based on the comparison of the generated reflection profile and the target reflection profile.

52. (Original) A test structure, comprising:

a plurality of lines; and

a plurality of contact openings defined in the lines.

53. (Original) The test structure of claim 52, further comprising a first layer, the lines being defined in the first layer.

54. (Original) The test structure of claim 52, further comprising a first layer and a second layer formed over the first layer, the lines being defined in the second layer.

55. (Original) The test structure of claim 52, wherein the contact openings in one line are aligned with the contact openings in an adjacent line.

56. (Original) The test structure of claim 52, wherein the contact openings in one line are offset with respect to the contact openings in an adjacent line.

57. (Original) The test structure of claim 53, wherein the first layer comprises an insulative layer.

58. (Original) The test structure of claim 57, wherein the insulative layer comprises at least one of silicon dioxide, silicon nitride, silicon oxynitride, and silicon rich oxide.

59. (Original) The test structure of claim 54, wherein the second layer comprises an insulative layer.

60. (Original) The test structure of claim 59, wherein the insulative layer comprises at least one of silicon dioxide, silicon nitride, silicon oxynitride, and silicon rich oxide.

61. (Original) The test structure of claim 54, wherein the first layer comprises a photoresist layer.

62. (Original) The test structure of claim 55, wherein the second layer comprises a photoresist layer.

63. (Previously Presented) A metrology tool, comprising:

means for receiving a wafer having a test structure comprising a plurality of lines and a plurality of contact openings defined in the lines;

means for illuminating at least a portion of the contact openings with a light source;

means for measuring light reflected from the illuminated portion of the contact openings to generate a reflection profile; and

means for determining a dimension of the contact openings based on the determined contact opening dimension.

64. (Original) The metrology tool of claim 63, further comprising:

means for comparing the generated reflection profile to a library of reference reflection profiles, each reference reflection profile having an associated contact opening dimension metric;

means for selecting a reference reflection profile closest to the generated reflection profile; and

means for determining the dimension of the contact openings based on the contact opening dimension metric associated with the selected reference reflection profile.

65. (Original) The metrology tool of claim 63, further comprising:

means for comparing the generated reflection profile to a target reflection profile; and

means for determining the dimension of the contact openings based on the comparison of the generated reflection profile and the target reflection profile.

66. (Previously Presented) The method of claim 1, wherein providing the wafer having the test structure further comprises providing the wafer having the test structure comprising a plurality of lines each having a width and a plurality of contact openings defined in the lines, each contact opening having a diameter less than the width of the line in which is defined.

67. (Previously Presented) The method of claim 13, wherein providing the wafer having the test structure further comprises providing the wafer having the test structure comprising a plurality of lines each having a width and a plurality of contact openings defined in the lines, each contact opening having a diameter less than the width of the line in which it is defined.

68. (Previously Presented) The method of claim 23, wherein providing the wafer having the test structure further comprises providing the wafer having the test structure comprising a plurality of lines each having a width and a plurality of contact openings defined in the lines, each contact opening having a diameter less than the width of the line in which it is defined.

69. (Previously Presented) The metrology tool of claim 33, wherein each line has a width and each contact opening has a diameter less than the width of the line in which it is defined.

70. (Previously Presented) The processing line of claim 40, wherein each line has a width and each contact opening has a diameter less than the width of the line in which it is defined.

71. (Previously Presented) The metrology tool of claim 50, wherein each line has a width and each contact opening has a diameter less than the width of the line in which it is defined.

72. (Previously Presented) The metrology tool of claim 51, wherein each line has a width and each contact opening has a diameter less than the width of the line in which it is defined.

73. (Previously Presented) The test structure of claim 51, wherein each line has a width and each contact opening has a diameter less than the width of the line in which it is defined.

74. (Previously Presented) The metrology tool of claim 63, wherein each line has a width and each contact opening has a diameter less than the width of the line in which it is defined.